Inflation Targeting in Latin America: Toward a Monetary Union?

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Abstract

In recent years five of the main economies in Latin America –Brazil, Chile, Mexico, Colombia and Peru– have adopted Inflation Targeting regimes. In the context of these converging monetary strategies, would the IT nations in the region be better off adopting a common currency? Would they be better off if they dollarize? Would a common currency among them be a better alternative than a dollarization? The answers to these questions are yes, yes and maybe.

Keywords: Monetary Union, Inflation Targeting, Latin America, Monetary Policy.

JEL classification: E31, E32, E42, E58.

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Convergence on regional monies is a no-brainer, Dornbusch (2001)

1 Introduction

Since the early 90s a growing number of industrialized and developing economies have adopted inflation targeting (IT) regimes operated by independent and more transparent Central Banks. Rose (2006) has labeled this a New International Monetary System. In his words "Inflation Targeting is Bretton Woods, reversed". In Latin America (LA) five of the main economies have adopted IT, namely, Brazil, Chile, Colombia, Mexico and Peru. These five countries hold more than 380 million people and their combined GDP amounts to 70% of Latin American and Caribbean GDP. Close to three quarters of the total trade of LAC takes place in these five countries. Since 2000, each of them has kept inflation in single digits, a notable achievement under the light of LA's inflation history of the last 40 years.

Within the context of converging monetary strategies among these five nations, a natural question to ask is whether these countries would be better off if they adopted a common currency –i.e., if they form a Latin American Monetary Union, LAMU–. The answer this paper gives to this first question is yes.

In the late 90s in both academic and policy circles, the idea of dollarization (rather than LAMU) in LA was seriously considered, especially after Argentina's president proposed such a move. The idea was extensively discussed at the IMF, IADB and even at the FED and at the US Congress (IMF, 1999). Nevertheless, only Ecuador and El Salvador gave up their monetary autonomy in favor of the dollar. In the aftermath of the discussions, it became clear that building political support for dollarization in LA is difficult. A popular quote at the time of the discussions said that Argentina would adopt the dollar as soon as the US put Eva Peron on the dollar bill. I believe that the political barriers of a multilateral Latin American monetary union would be much weaker that those faced by a dollarization. That said, in the empirical part of the paper, I also analyze economic pros and cons of a unilateral adoption of the US dollar by each of the inflation targeters in LA. I find that giving up monetary autonomy –this time in favor of the dollar– would also leave countries better off from an economic standpoint.

Having found that both a monetary union and a dollarization make economic sense, the paper then asks which of the two strategies is preferred. The results are mixed. I find that LAMU is strictly preferred to dollarization in the cases of Chile, Peru and Brazil. The opposite is true for Mexico,

while in Colombia the net benefits of both common currency arrangements are similar.

In what follows the paper pursues a twofold strategy. On the one hand, I build a simple policy model that captures several costs and benefits for a group of IT countries considering to form a monetary union. Then, using the lessons from the model and results from the large literature on monetary unions, I report estimates on the benefits and costs associated with a LAMU and a unilateral dollarization.

The paper also makes a methodological contribution by proposing a way to compare some consequences of common currencies that can be measured in terms of GDP (e.g., the consequences via increased trade or the foregone seignorage collection) with other traditionally more intangible consequences such as the potential increase in volatility. As explained in the final section of the paper, I use self reported satisfaction surveys to build country specific indifference curves between volatility and growth that help put in perspective the relative importance of the volatility exacerbation that the adoption of a common currency could entail.

The rest of the paper is organized as follows. Section 2 briefly describes the IT adoption dates and inflation characteristics of the inflation targeters in LA. Section 3, turns to the theoretical model. Section 4, turns to the empirical aspects providing several quantifications, one at a time, of each of the costs and benefits of a LAMU and a dollarization. Section 5 puts the empirical results together while 6 concludes and offers further discussion.

2 Inflation Targeting in Latin America

From a theoretical standpoint, proponents of IT claim several benefits associated with this monetary policy framework. They range from lower inflation and inflation variability, solution to the classic time inconsistency problem faced by Central Banks, to the anchoring of lower inflationary expectations, among others. At the empirical level, economists have also studied the impact of IT on macroeconomic aggregates. Ball and Sheridan (2005) and Lin and Ye (2007), using a sample of industrialized nations, show that the recent disinflation and the reduction in inflation volatility are not attributable to the adoption of IT. Nevertheless, Gonçalves and Salles (2007) and Lin and Ye (2009), find that IT played a relevant role in driving down inflation and growth volatility in emerging economies.

In recent times, five of the main economies in LA adopted inflation targeting regimes. Figure 1 depicts the recent inflation history of these coun-

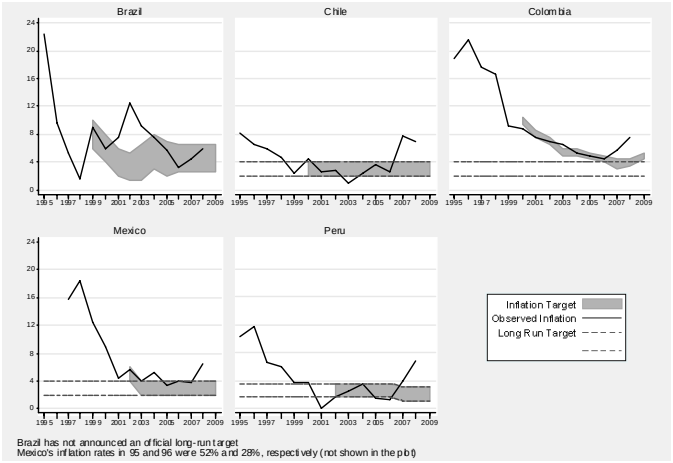

Figure 1: Inflation and inflation targets in Latin American IT countries.

tries, along with the inflation targets and long-run inflation goals.[1]

Colombia, Chile and Mexico have long run inflation targets set at 3%, while Peru's goal is 2.0% (starting in 2007). In all of these cases, the target is set with a $\pm 1\%$ margin. Brazil has not officially announced its long run goal and its short term targets are announced with a wider band than in the rest of the countries. This has allowed Brazil to exhibit inflation rates within the target band even in 2007 and 2008 when the inflationary pressures deviated inflation form targets in the remaining IT countries.

3 The Model

I follow a modelling approach similar to the one proposed by Alesina and Grilli (1992) to evaluate the costs and benefits of joining a monetary union. I depart from their model by explicitly incorporating the IT strategies that characterize the monetary policy framework of the countries proposed to form the initial LAMU. In the model, both the members of the potential union and the Union's Central Bank target inflation.

I first describe the problem of the union's central bank and analyze the

[1] The starting date of IT is controversial in Chile. Some set it at the beginning of the 90s; others claim that the full IT artillery was only displayed in the third quarter of 1999. We follow the latter trend, as proposed in Batini and Laxton (2005) and De Gregorio (2006).

welfare implications for individual countries joining the union. I then ask what happens if countries retain monetary autonomy. Finally, I analyze the convenience of giving up monetary autonomy by comparing welfare in these two scenarios.

Union's problem: Suppose there is a single Latin American Central Bank (Union) setting policy to minimize a loss function a la Barro-Gordon –i.e., a function trading off unemployment and inflation in the union. In addition to the traditional Barro-Gordon elements, the Latin American Central Bank uses an inflation targeting strategy. Thus, the union's Central Bank minimizes

$$\mathcal{L}_u = \frac{\lambda}{2}(U_u - \overline{U_u})^2 + \frac{1}{2}(\pi_u - \pi^*)^2 + \frac{h}{2}(\pi_u - \pi_u^T)^2 \tag{1}$$

where λ represents the relative weight put on unemployment fluctuations, U_u represents the unemployment rate of the union, π_u is the union's inflation rate, π^* is the optimal inflation rate which can be thought of as the *long run* target, π_u^T is the bank's (short run) inflation target and h is the weight given by the Central Bank to the deviation of inflation from its target. $\overline{U_u}$ is the unemployment target measured relative to the natural unemployment rate, i.e., if the bank targets an unemployment rate below the natural rate, then $\overline{U_u} < 0$. The natural unemployment rate has been normalized to zero.

The Central Bank of the union minimizes this expression by choosing π_u subject to a Phillips curve given by:

$$U_u = -(\pi_u - \pi_u^e) + \varepsilon \tag{2}$$

where π_u^e represents expected inflation and ε is a supply shock. This is a standard expectations augmented Phillips curve, where the natural rate of unemployment is again normalized to zero.

Solution to this problem setting for now $h = 0$ (i.e., without an inflation targeting strategy) leads to the following inflation rate for the union:

$$\pi_u = -\lambda\overline{U_u} + \pi_u^* + \frac{\lambda}{1+\lambda}\varepsilon \tag{3}$$

The first term represents the well known inflation bias (recall that $\overline{U_u} < 0$, as long as the Central Bank targets unemployment rates below the natural rate), which grows with the gap between the natural and target level of unemployment and with the weight given by the Central Bank to unemployment relative to inflation stabilization. This is the traditional Barro-Gordon result, where the impossibility by the Central Bank to credibly commit to lower inflation rates generates persistent inflation above the optimal rate.

Under inflation targeting ($h \neq 0$) the inflation rate of the union will be

$$\pi_u = \frac{-\lambda}{1+h}\overline{U_u} + \pi^* + \frac{h}{1+h}\Theta + \frac{\lambda}{1+\lambda+h}\varepsilon \tag{4}$$

where $\Theta = \pi_u^T - \pi^*$. Several well-known results emerge. If $\Theta = 0$, i.e., if the Central Bank targets the optimal long-run rate, the inflation bias is smaller than without inflation targeting (augmenting welfare) but the reaction to supply shocks is diminished (which negatively affects welfare).[2] This is technically analogous to Rogoff's (1985) conservative Central Banker problem, that is, the optimal h is positive. An inflation targeting Central Bank increases welfare if $\Theta = 0$.

Of course, if Θ is positive, i.e., if the Central Bank targets an inflation rate above the long-run optimal rate, then the inflation targeting strategy can be welfare diminishing. In practice, this could happen in scenarios where the Central Bank is disinflating using a gradualist strategy to bring inflation down to its long-run optimal rate. Finally, note that under strict inflation targeting as proposed by Svensson (1997), i.e., if $h \longrightarrow \infty$, both the inflation bias and the reaction to supply shocks, disappear.

Welfare implications of membership: For welfare analysis and in the absence of a *political* union, each member country j, should evaluate the policy delivered by the union based on its own social loss function,

$$\mathcal{L}_j = \frac{\lambda_j}{2}(U_j - \overline{U_j})^2 + \frac{1}{2}(\pi_u - \pi^*)^2 \tag{5}$$

considering that it faces a country-specific Phillips curve given by

$$U_j = -(\pi_u - \pi_u^e) + \varepsilon_j \tag{6}$$

Each country in the union can have different preferences, unemployment rates and face idiosyncratic shocks; nevertheless, the country's inflation rate will be the same as the union's.[3] The *society's* loss function does not include the inflation targeting term; the latter is a policy strategy of the Central Bank, but not part of the social preferences.

The expected loss of membership can be found by substituting (6) and

[2] Note that for welfare evaluations, one should use the society's welfare function, which does not include the inflation targeting term.

[3] Alesina and Grilli (1992) explore the case where inflation in a member differes from inflation in the union.

(4) into (5) and taking expectations. The resulting expression is

$$E\mathcal{L}_j^{mem} = \frac{\lambda_j}{2}\left[\left(\frac{\lambda}{1+\lambda+h}\right)^2\sigma_\varepsilon^2 + \sigma_{\varepsilon_j}^2 - \frac{2\lambda}{1+\lambda+h}\sigma_{\varepsilon\varepsilon_j} + \overline{U_j}^2\right] + \frac{1}{2}\left[\left(\frac{\lambda}{1+h}\right)^2\overline{U_u}^2 + \left(\frac{h\Theta}{1+h}\right)^2 - \frac{2\lambda h\Theta\overline{U_u}}{(1+h)^2} + \left(\frac{\lambda}{1+\lambda+h}\right)^2\sigma_\varepsilon^2\right] \quad (7)$$

where σ_ε^2 and $\sigma_{\varepsilon_j}^2$ are the variance of ε and ε_j, respectively, and $\sigma_{\varepsilon\varepsilon_j}$ is the covariance between ε and ε_j.

The problem in Autarky: If each country were to retain autonomy over its monetary policy, it would minimize

$$\mathcal{L}_j = \frac{\lambda_j}{2}(U_j - \overline{U_j})^2 + \frac{1}{2}(\pi_j - \pi^*)^2 + \frac{h_j}{2}(\pi_j - \pi_j^T)^2 \quad (8)$$

subject to (6). I allow for an idiosyncratic target, that is, π_j^T is not necessarily equal to π^T. Nevertheless, the optimal inflation rate (π^*) is assumed to be equal in the union and across individual members of the union. The problem and the solution are very similar to the union's. I omit the details.

Welfare implications of autarky: The expected loss of retaining monetary autonomy, –obtained by replacing the solution to the problem in autarky into the country specific social loss function– is

$$E\mathcal{L}_j^{aut} = \frac{\lambda_j}{2}\left[\left(\frac{1+h_j}{1+\lambda_j+h_j}\right)^2\sigma_{\varepsilon_j}^2 + \overline{U_j}^2\right] + \frac{1}{2}\left(\frac{\lambda_j}{1+h_j}\right)^2\overline{U_j}^2 + \frac{1}{2}\left[\left(\frac{h_j\Theta_j}{1+h_j}\right)^2 - \frac{2\lambda_j h_j\Theta_j\overline{U_j}}{(1+h_j)^2} + \left(\frac{\lambda_j}{1+\lambda_j+h_j}\right)^2\sigma_{\varepsilon_j}^2\right] \quad (9)$$

where $\Theta_j = \pi_j^T - \pi^*$.

Membership vs autarky: The difference between the two loss functions represents the key expression to analyze costs and benefits of joining

a union vis a vis retaining monetary autonomy:

$$
\begin{aligned}
E\mathcal{L}_j^{mem} - E\mathcal{L}_j^{aut} = \frac{1}{2}\left[\left(\frac{\lambda}{1+h}\right)^2 \overline{U_u}^2 - \left(\frac{\lambda_j}{1+h_j}\right)^2 \overline{U_j}^2\right] \\
+ \frac{(1+\lambda_j)}{2}\left[\left(\frac{\lambda}{1+\lambda+h}\right)^2 \sigma_\varepsilon^2 - \left(\frac{\lambda_j}{1+\lambda_j+h_j}\right)^2 \sigma_{\varepsilon_j}^2\right] \\
+ \frac{1}{2}\left[-2\lambda_j\left(\frac{\lambda}{1+\lambda+h}\sigma_{\varepsilon\varepsilon_j} - \frac{\lambda_j}{1+\lambda_j+h_j}\sigma_{\varepsilon_j}^2\right)\right] \\
+ \frac{1}{2}\left[\left(\frac{h\Theta}{1+h}\right)^2 - \left(\frac{h_j\Theta_j}{1+h_j}\right)^2 - 2\left(\frac{\lambda h\Theta\overline{U}}{(1+h)^2} - \frac{\lambda_j h_j \Theta_j \overline{U_j}}{(1+h_j)^2}\right)\right] \quad (10)
\end{aligned}
$$

Differences in welfare from participating in a monetary union versus retaining autonomy come from two sources: preferences and shocks. I analyze each source of differences, one at a time. Here I focus on the long run scenarios, namely, those where inflation targets are equal to the optimal inflation ($\Theta_j = \Theta = 0$). This is likely the most relevant scenario given that before the union is implemented, countries would agree on having achieved similar inflation rates, likely close to their long run targets. Nevertheless, the short run model, where targets and optimal inflation rates might differ, leads to interesting insights that become relevant, for instance, during gradual disinflations. I develop these insights in the appendix.

3.1 Differences in Preferences

Let the shocks be identical across the economies, i.e., $\varepsilon = \varepsilon_j$ so that $\sigma_\varepsilon^2 = \sigma_{\varepsilon_j}^2 = \sigma_{\varepsilon\varepsilon_j} = \sigma^2$. Moreover, the long-run assumption implies that $\Theta_j = \Theta = 0$. Then, (10) collapses to

$$
\begin{aligned}
E\Delta\mathcal{L}_j = \frac{1}{2}\left[\left(\frac{\lambda}{1+h}\right)^2 \overline{U_u}^2 - \left(\frac{\lambda_j}{1+h_j}\right)^2 \overline{U_j}^2\right] \\
+ \frac{\sigma^2}{2}\left(\frac{\lambda}{1+\lambda+h} - \frac{\lambda_j}{1+\lambda_j+h_j}\right)\left(\frac{(1+\lambda_j)\lambda}{1+\lambda+h} - \lambda_j - \frac{\lambda_j h_j}{1+\lambda_j+h_j}\right) \quad (11)
\end{aligned}
$$

where $E\Delta\mathcal{L}_j = E\mathcal{L}_j^{mem} - E\mathcal{L}_j^{aut}$.

A1. Let $\overline{U_j} \neq \overline{U_u}$; $\lambda_j = \lambda$, $h_j = h$. Then $E\Delta\mathcal{L}_j$ can be written as

$$
\frac{1}{2}\left(\frac{\lambda}{1+h}\right)^2 \left(\overline{U_u}^2 - \overline{U_j}^2\right) \quad (12)
$$

The expression is negative as long as $\left|\overline{U_j}\right| > \left|\overline{U_u}\right|$, i.e., a country with incentives to high inflation, will always benefit from the monetary union. The credibility the monetary union bestows, positively affects welfare. Note that under strict inflation targeting, the effect disappears, as the inflation bias is removed both in the union and in country j.

A2. Let $\lambda_j \neq \lambda$; $\overline{U_j} = \overline{U_u}$, $h_j = h$. Then $E\Delta\mathcal{L}_j$ can be written as

$$\frac{1}{2}\left(\frac{\overline{U_u}}{1+h}\right)\left(\lambda^2 - \lambda_j^2\right) + \frac{\sigma^2}{2}\left(\frac{\lambda}{1+\lambda+h} - \frac{\lambda_j}{1+\lambda_j+h}\right)\left(\frac{(1+\lambda_j)\lambda}{1+\lambda+h} - \lambda_j - \frac{\lambda_j h}{1+\lambda_j+h}\right) \quad (13)$$

The interpretation of the first term is traditional in this literature; the union is welfare enhancing as long as $\lambda < \lambda_j$. The intuition is again that the union confers credibility to a country that has greater incentives to inflate.

The second line is always positive (as long as $\lambda < \lambda_j$), i.e., it favors maintaining an autonomous monetary policy. The whole expression is premultiplied by the variance of the shocks. The economic interpretation is simple: while the monetary union has less incentives to inflate when $\lambda < \lambda_j$, it will also react less to supply shocks, reducing welfare.

A3. Let $h_j \neq h$; $\overline{U_j} = \overline{U_u}$, $\lambda_j = \lambda$. Then $E\Delta\mathcal{L}_j$ can be written as

$$\frac{\lambda^2\overline{U_u^2}}{2}\left(\frac{1}{(1+h)^2} - \frac{1}{(1+h_j)^2}\right) + \frac{\sigma^2\lambda}{2}\left(\frac{1}{1+\lambda+h} - \frac{1}{1+\lambda+h_j}\right)\left(\frac{-h}{1+\lambda+h} - \frac{h_j}{1+\lambda+h_j}\right) \quad (14)$$

Consider the case where $h_j < h$, namely a scenario where the Union's Central Bank attaches a higher priority to the achievement of the inflation target than country j. The first term is negative. The reason is that the union would reduce the inflation bias by focusing more strongly on the inflation target. The second line is positive. It is premultiplied by σ^2 and captures the fact that the union's bank will smooth less the activity variations, –a negative impact on welfare from joining the union.

3.2 Differences in Shocks

Let the objective functions be identical across all j economies ($\overline{U_j} = \overline{U_u}$, $\lambda_j = \lambda$, $h_j = h$, $\Theta_j = \Theta$) but allow for different shocks, i.e., $\varepsilon \neq \varepsilon_j$. Then,

(10) collapses to

$$\frac{1}{2}\left(\frac{\lambda}{1+\lambda+h}\right)^2\left((1+\lambda)(\sigma_\epsilon^2+\sigma_{\varepsilon_j}^2-2\rho\sigma_\varepsilon\sigma_{\varepsilon_j})-2h(2\rho\sigma_\varepsilon\sigma_{\varepsilon_j}-\sigma_{\varepsilon_j}^2)\right) \quad (15)$$

where ρ is the correlation coefficient between ε and ε_j.[4]

B1. Consider the case where the size of the shocks differs but they are perfectly correlated, i.e., $\rho = 1$. In that case, (15) is simply

$$\frac{1}{2}\left(\frac{\lambda}{1+\lambda+h}\right)^2\left((1+\lambda)(\sigma_\epsilon-\sigma_{\varepsilon_j})^2+2h(\sigma_{\varepsilon_j}^2-\sigma_\varepsilon\sigma_{\varepsilon_j})\right) \quad (16)$$

Note that $(\sigma_\epsilon-\sigma_{\varepsilon_j})^2$ is always positive. This is the Alesina-Grilli result where differences in output (unemployment) variances make entering the union less attractive. The intuition is that relative to an autonomous bank, the monetary union would under- or over stabilize.

The expression $(\sigma_{\varepsilon_j}^2-\sigma_\varepsilon\sigma_{\varepsilon_j})$ is negative if $\sigma_\varepsilon > \sigma_{\varepsilon_j}$. That is, if the variance of the union is higher than that of country j, joining the union improves welfare in country j. Why is that? Note that the latter expression is premultiplied by h, the weight given to the inflation target. Recall, moreover, that countries targeting inflation react less to supply shocks, a welfare reducing feature of IT. Now, if $\sigma_\varepsilon > \sigma_{\varepsilon_j}$ then the variance of shocks of the union is of greater magnitude than the one in country j, and the inflation targeting union will react to the fully correlated shocks more than the autonomous bank would. In this scenario, the negative implication of IT, namely that it reacts less to supply shocks, is mitigated from the perspective of country j. Note that if the variance of economic activity in country j is larger than that of the union, the opposite implication is reached.

B2. Consider $\sigma_\varepsilon = \sigma_{\varepsilon_j} = \sigma$, but $\rho \neq 1$. In that case, (15) is simply

$$\frac{\lambda^2}{1+\lambda+h}\sigma^2\,(1-\rho) \quad (17)$$

The less correlated the shocks, the worse it becomes to join the union. In the extreme case where $\rho = -1$ the union's Central Bank would implement expansionary policies when contractions are needed in country j. Nevertheless, note that the expression is mitigated by the presence of h, the weight given to inflation targeting. Given that an IT regime reacts less to economic activity fluctuations, a bank that reacts to shocks that go in the opposite direction of the one needed in country j, does less harm.

[4] The expression does not depend on Θ. Welfare implications of the shocks will be analogous in the long- and the short run.

4 LAMU, Autonomy or dollarization: A first look

While the model highlights several elements for evaluating the convenience of joining a monetary union, it also left aside several relevant considerations. For instance, the literature highlights that the reduction in transaction costs when joining a union increases trade and could have a long-run impact on GDP. Moreover, if the union is a unilateral policy (i.e., a dollarization), countries give up their present and future seignorage collection. Both of these effects are estimated and discussed later in the section. There are other relevant elements that I leave aside in this analysis. For instance, a LAMU may be a pivotal element in an economic integration process in LA. The economic benefits are part of a larger story –one where the long run political gains of putting in place the building blocks of a Latin American nation, might outweigh the economic considerations.[5] These aspects should be part of the future discussion but go beyond the objectives of this paper.

Two additional caveats: I evaluate costs and benefits of LAMU as if it were only to occur among the current inflation targeters in LA. Nevertheless, if the process turns out to be successful, it is conceivable that other countries in the region would join it, as has been the case with the Euro. Finally, when analyzing a dollarization, results should be read as the consequences for each country of dollarizing unilaterally –not as if all inflation targeters were simultaneously to adopt the dollar.

I divide the rest of the section into three parts. 4.1 deals with shocks and credibility; 4.2 quantifies the seignorage forgone if countries dollarize while 4.3 analyzes the trade effects. Later, in section 5, I put all results together.

4.1 Shocks and credibility

The model suggests the following: (i) Credibility: Countries with high incentives to inflation benefit more from a union, although the result is attenuated with IT. (ii) Correlation: Countries would like to have shocks as correlated as possible with those of the union. (iii) Variance of shocks: With IT, having a smaller variance of shocks relative to the union's, is desirable. I now take these ideas to the data to see which countries would benefit the most relative to others and, when appropriate, state whether a union or a dollarization is more convenient.

(i) Credibility: I use two proxies of incentives to inflate under autonomy. One is the actual behavior of inflation during the recent past. The other, are measures of the degree of independence of the Central Banks,

[5] See, for instance, Krugman (1989) for a similar discussion for the European Union.

taken from Jácome and Vázquez (2005): the GMT index, going from 0 to 15, with 15 being the maximum independence; the Cukierman and the modified Cukierman indices, going from 0 to 1 and also increasing in the degree of independence (see appendix for details).

To summarize the information contained in the two proxies, I build a credibility index –the average of an inflation index and the Modified Cukierman Index (the preferred CBI index according to Jácome and Vasquez, 2005). The inflation index, is built as follows: $(\pi_{\max} - \pi_i)/(\pi_{\max} - \pi_{\min})$, where $\pi_{\max}$ is the highest average inflation rate for the period 2000 to 2007 within LA; $\pi_{\min}$, accordingly, is defined as the lowest inflation in the region for the same period, while π_i is the average inflation rate for country i, for the same period. Thus, the country with the smallest inflation rate in LA will have an *inflation* index of 1, while the country with the largest inflation rate in LA will have an index of 0. To build the *credibility* index, I average this outcome with the Modified Cukierman Index. The closest the number to 1, the better the credibility and, thus, less gains are to be expected in that front from joining a monetary union or dollarizing. (Note that dollarization and LAMU cannot be compared to one another from the perspective of credibility, unless I make specific assumptions as to the credibility changes that each monetary arrangement would bestow. I do not do that in this paper).

Results are reported in Table 1. From the credibility's perspective, Brazil and Colombia would benefit the most from a union while Chile and Peru would benefit the least. Moreover, IT countries in LA exhibit lower inflation rates and higher CBI indexes and thus credibility indexes, compared to non IT countries in the region.

	Central Bank Independence Indexes**			Average Inflation 2000-2007	Credibility Index
	GMT	Cukierman Index	Modified Cukierman		
Brazil	10	0,47	0,50	7,16%	0,61
Chile	14	0,84	0,85	3,27%	0,89
Colombia	10	0,78	0,83	5,95%	0,81
Mexico	13	0,75	0,81	4,34%	0,84
Peru	13	0,86	0,86	1,99%	0,93
Average IT in LAC	12,0	0,74	0,77	4,54%	0,81
Average non- IT in LAC*	10,6	0,71	0,69	9,53%	0,64

* Countries included are: Argentina, Bolivia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, Paraguay, Uruguay, Venezuela

** Source: Any Link Between Legal Central Bank Independence and Inflation? Evidence from Latin America and the Caribbean. Luis I. Jácome and Francisco Vásquez. IMF Working Paper. 2005.

Table 1

(ii) Correlation: Our model suggests countries would like to have busi-

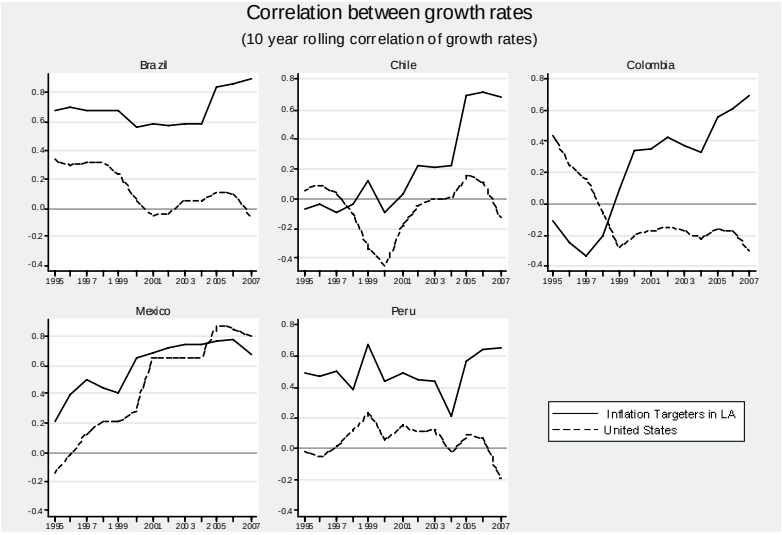

Figure 2:

ness cycles as correlated as possible with the union's. I begin reporting the correlation of the GDP growth rates of each IT nation in LA with the union and with the US.[6] Specifically, Figure 2 plots 10-year rolling correlation of growth rates. The Figure shows that the correlation of individual countries with a potential LAMU are considerably higher than the correlations with the US. The only exception is Mexico, where the correlation with the US is similar to the union's. Nafta has likely played a big role in explaining this outcome. In any case, by 2007, the average growth correlation of the five IT countries in LA with the potential union reaches 0.72, while the same statistic with the US is only 0.02. In the correlation front, the advantage of LAMU over dollarization is large.

The comparison within IT countries shows that the higher correlations are those of Brazil. This is not surprising given that Brazil is the largest economy in the region and therefore plays a large role driving the joint business cycles of the five inflation targeters in LA. In this sense, it plays a role similar to Germany's within the Euro area.

(iii) Standard deviation of the shocks: The Alesina-Grilli classical result calls for shocks as similar as possible in size. Our model stresses that

[6] The model was expressed in term of unemployment, but analogous results are obtained if the loss function and the Phillips curve are expressed in terms of output. I use output given that unemployment statistics are not comparable across LAC countries.

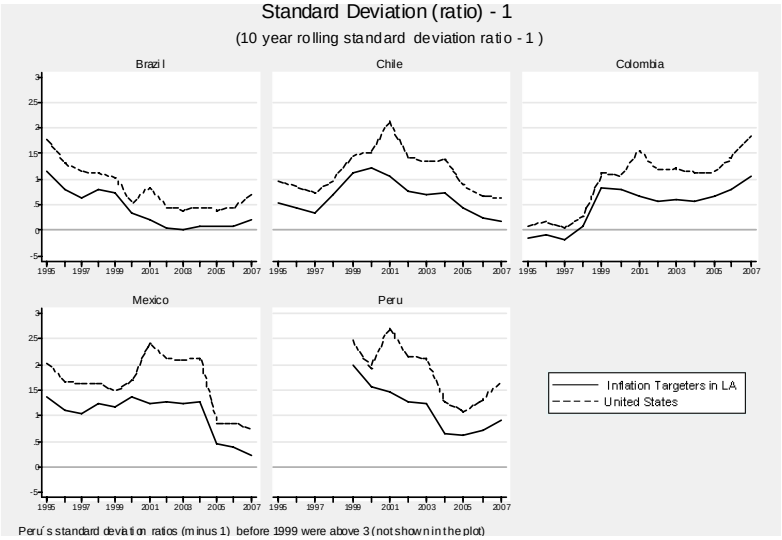

Figure 3:

under IT, having a standard deviation of shocks below the union's can also favor the union. In Figure 3, I report 10-year rolling standard deviation ratios of growth rates of country j relative to the LAMU or the US, minus 1. One would like this statistic to be as close to zero (the Alesina-Grilli argument) or negative (our additional effect due to IT). Interestingly, for all countries analyzed, the ratio of the union is always below the ratio with the US. In the standard deviation front, LAMU also seems preferable when compared to unilateral dollarization.

Putting Business Cycles results together: To put results (ii) and (iii) in perspective, I build a business cycle index, defined as $(\sigma_i/\sigma - 1) + (1 - \rho_i)$, where σ_i/σ is the relative standard deviation while ρ_i is the growth correlation of country i with LAMU's growth rate. Our model suggests that the first term should be small or even negative in order for the union to be beneficial, while the second term should be as close to zero as possible; the closer the business cycle index to zero, the better it is to join the LAMU. The evolution of the index over time for each IT country in our sample is reported in Figure 4.

The results show that the LAMU is preferred in all countries. The differences are large in all cases except in Mexico. The ranking of countries that gain more with a union from the perspective of business cycles is led by Brazil, followed by Chile and Mexico and then Peru and Colombia. Later,

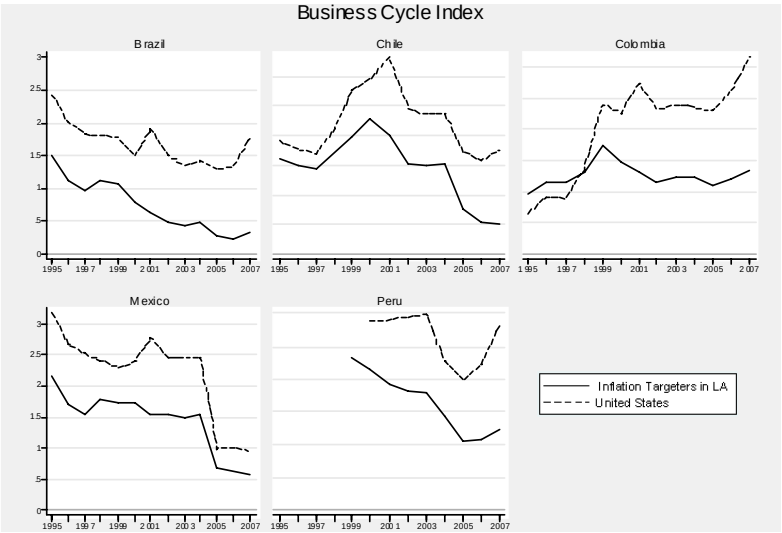

Figure 4:

in section 5, I sophisticate the measurement of the costs associated with the potential volatility exacerbation due to giving up monetary autonomy.

4.2 Seignorage

If the five inflation targeters in LA were to form a monetary union, they would likely agree on a formal sharing rule of the stream of seignorage revenue. Nevertheless, if any of them decides to dollarize, it is unlikely that the US would agree to discuss a seignorage sharing rule. Thus, in a cost-benefit analysis of a union vis a vis a dollarization, it becomes vital to assess the size of present and future seignorage revenues forgone when the choice is to dollarize. In calculating those costs, I follow closely the framework proposed by Schmitt-Grohé and Uribe (1999).

Let B_0 be the monetary base at time 0 of the country dollarizing, denominated in dollars. Suppose, that all foreign reserves are held in US Treasury Bills yielding a constant nominal interest rate, i. At the time the country implements the dollarization, it sells B_0 of its foreign reserves to the US in exchange for dollar bills, then used to buy the entire monetary base. The loss of reserves is B_0, so that in period 0 the amount of seignorage income forgone is iB_0.

For $t > 0$, the demand for monetary assets grows over time both be-

cause of inflation (π) and domestic real growth (g), for simplicity assumed constant. Furthermore, assume a unitary income elasticity of real money balances, so that domestic dollar holdings in any period $t \geq 0$ will be $D_t = [(1+g)(1+\pi)]^t B_0$. Finally, citing Schmitt Grohe and Uribe (1999) "Under dollarization the way in which the increase in the domestic country's money holdings, $D_t - D_{t-1}$, is brought about is through transfers of real resources from the domestic economy to the U.S. government in exchange for U.S. dollars. The U.S. government in turn can earn interest on these real resources.[...] the stream of income earned by the U.S. government in each period $t \geq 0$ is given by iD_t." Noting that , the present discounted value of seignorage income forgone (earned by the US), is

$$S = \sum_{t=0}^{\infty} \left(\frac{1}{1+i}\right)^t i\left[(1+g)(1+\pi)\right]^t B_0$$

If $r > g$ and $(1+i) = (1+r)(1+\pi)$, S converges to $iB_0\frac{(1+r)}{r-g}$.[7] Under column (1) in Table 2, I report estimates of S as a % of 2007 GDP of each of the IT countries for baseline values of π, r and g. of 3%, 5% and 4% respectively. Results suggest that the seignorage forgone as a % of one year's GDP are large –they range from 43% up to 114%.

Present discounted value of seignorage income forgone as a % of GDP. Estimates based on 2007 data.											
	Baseline	Sensitivity analysis									
	π=3%, r=5%, g=4%	π=2%	π=4%	π=5%	r=4.5%	r=5.5%	r=6.5%	g=2%	g=3%	g=4.5%	average (2)-(10)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Brazil	83%	72%	94%	105%	155%	59%	40%	28%	42%	166%	85%
Chile	88%	77%	100%	111%	164%	63%	43%	29%	44%	176%	90%
Colombia	78%	68%	88%	98%	145%	55%	37%	26%	39%	155%	79%
Mexico	43%	38%	49%	55%	81%	31%	21%	14%	22%	87%	44%
Peru	114%	99%	129%	143%	213%	81%	55%	38%	57%	228%	116%
Average	81%	71%	92%	102%	152%	58%	39%	27%	41%	163%	83%

Table 2

Under columns (3) through (11), I perform sensibility analysis by reporting results with alternative values of π, r and g. Seignorage foregone obviously grows with inflation and GDP growth and falls with increases in the real interest rate. Under column (11) I report the average of columns (2) through (10). Although on average, the sensibility analysis is very close to our baseline case, there is a great variation across columns. The results are particularly sensible to changes in the real growth rate, with column (10) reporting estimates that are 6 times larger than column (8).

[7] $r > g$ is a standard steady-state condition in optimizing growth models. If $g > r$, S goes to infinity.

4.3 The trade effect

In a very influential paper, Rose (2000) estimated that belonging to a currency union triples trade with other union members. This surprising result sparked a lot of research –with skeptical economists trying to find arguments to shrink the effects estimated by Rose (for an excellent summary of the literature see Baldwin, 2006). Nevertheless, even skeptics of Rose's results, as Baldwin, estimate the effect of currency unions on trade to be very large. In describing the effect of the Euro adoption on trade in Euroland, Baldwin claims "the number is between 5% and 10% to date. Most of the evidence suggests that this number may grow as time passes, maybe even doubling." In other words, even a critic of Rose's results finds it plausible that a currency union could increase trade by a factor of 1,2. Rose and Stanley (2005) in their *meta-analysis* from 34 studies on the subject, conclude that currency unions increase bilateral trade by between 30% and 90%.

In a subsequent paper, Frankel and Rose (2002) estimate the effect of common currencies on long run income (via trade). They find that a 1% increase in the ratio of trade to GDP increases GDP per capita by one third of a percent in the long run.

I estimate the benefits via increased trade and indirectly via increases in long run GDP of a union among the five inflation targeters and contrast it with a unilateral dollarization by each of these nations. I estimate the impact of currency unions with two alterative scenarios: the pessimistic scenario, where trade 'only' increases by a factor of 1,2. This is consistent with Baldwin's view and roughly coincides with Rose and Stanley's lower bound. In the other scenario –i.e., the more optimistic one, yet still conservative when compared with Rose's original results– the common currency increases trade by a factor of 2. This case is roughly consistent with Rose and Stanley's upper bound. I then use Frankel and Rose's results to estimate the effect of increased trade on long run GDP in each of the scenarios.

Table 3 reports the results. The first 3 columns report actual data for the 5 inflation targeters in LA. It is notable how trade has gained importance as a % of GDP. From an average of 27% by 1990, it reached 46% in 2007. Interestingly, the relative importance of trade among the IT members has also gained ground. By 2007 it reached 11% on average.

Next, columns (4) and (5) report the estimated impact of dollarizing both on trade and on GDP per capita. For instance, the number for Brazil in 1990 under the (left) column (4) is obtained by multiplying the numbers under column (1) and (2) times 1,2. Then, the number under (left) column (5) is simply a third of the number in column (4) –that is, I assume as in

Frankel and Rose, that a 1% increase in overall trade raises GDP by one third of a percent. Columns (6) and (7) report the same as (4) and (5), but now for a union among the inflation targeters in LA.

		Trade (% of GDP)	% of trade with the US	% of trade with other IT in LA	Effects (% of GDP) of dollarizing		Effects (% of GDP) of "LAMU"	
					On Trade	On GDP	On Trade	On GDP
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Brazil	**1990**	12%	23%	4%	[3% 5%]	[1% 2%]	[1% 1%]	[0% 0%]
	1995	13%	21%	5%	[3% 6%]	[1% 2%]	[1% 1%]	[0% 0%]
	2000	18%	24%	6%	[5% 8%]	[2% 3%]	[1% 2%]	[0% 1%]
	2005	22%	19%	7%	[5% 8%]	[2% 3%]	[2% 3%]	[1% 1%]
	2007	21%	16%	7%	[4% 7%]	[1% 2%]	[2% 3%]	[1% 1%]
Chile	**1990**	49%	18%	10%	[11% 18%]	[4% 6%]	[6% 10%]	[2% 3%]
	1995	43%	19%	13%	[10% 17%]	[3% 6%]	[7% 11%]	[2% 4%]
	2000	46%	18%	14%	[10% 17%]	[3% 6%]	[8% 13%]	[3% 4%]
	2005	58%	16%	15%	[11% 19%]	[4% 6%]	[11% 18%]	[4% 6%]
	2007	66%	14%	15%	[11% 19%]	[4% 6%]	[12% 19%]	[4% 6%]
Colombia	**1990**	31%	40%	7%	[15% 25%]	[5% 8%]	[2% 4%]	[1% 1%]
	1995	26%	35%	9%	[11% 18%]	[4% 6%]	[3% 5%]	[1% 2%]
	2000	30%	42%	10%	[15% 25%]	[5% 8%]	[4% 6%]	[1% 2%]
	2005	34%	35%	13%	[15% 24%]	[5% 8%]	[5% 9%]	[2% 3%]
	2007	37%	31%	14%	[13% 22%]	[4% 7%]	[6% 10%]	[2% 3%]
Mexico	**1990**	21%	69%	2%	[18% 29%]	[6% 10%]	[0% 1%]	[0% 0%]
	1995	53%	79%	2%	[50% 84%]	[17% 28%]	[1% 2%]	[0% 1%]
	2000	59%	81%	1%	[57% 95%]	[19% 32%]	[1% 2%]	[0% 1%]
	2005	57%	69%	3%	[47% 79%]	[16% 26%]	[2% 3%]	[1% 1%]
	2007	62%	66%	3%	[49% 81%]	[16% 27%]	[2% 4%]	[1% 1%]
Peru	**1990**	23%	25%	13%	[7% 11%]	[2% 4%]	[3% 6%]	[1% 2%]
	1995	24%	22%	16%	[6% 11%]	[2% 4%]	[5% 8%]	[2% 3%]
	2000	27%	26%	15%	[8% 14%]	[3% 5%]	[5% 8%]	[2% 3%]
	2005	37%	25%	17%	[11% 19%]	[4% 6%]	[8% 13%]	[3% 4%]
	2007	44%	19%	17%	[10% 17%]	[3% 6%]	[9% 15%]	[3% 5%]
Average 1990		27%	35%	7%	[11% 18%]	[4% 6%]	[3% 4%]	[1% 1%]
Average 1995		32%	35%	9%	[16% 27%]	[5% 9%]	[3% 5%]	[1% 2%]
Average 2000		36%	38%	9%	[19% 32%]	[6% 11%]	[4% 6%]	[1% 2%]
Average 2005		42%	33%	11%	[18% 30%]	[6% 10%]	[5% 9%]	[2% 3%]
Average 2007		46%	29%	11%	[18% 29%]	[6% 10%]	[6% 10%]	[2% 3%]

Source of (1), (2) and (3): United Nations Commodity Trade Statistics Database (UN COMTRADE)- http://comtrade.un.org/db and World Development Indicators (WDI), http://devdata.worldbank.org/dataonline/

(4) and (6): Left column assumes that the common currency increases trade by 20%. Right column assumes that the common currency doubles trade with other members.

(5) and (7): We use Frankel and Rose's estimate, namley that a 1% increase in trade, incrases GDP by one third of a percent.

Table 3

On average, trade would raise by between 18% and 29% in a dollarization. As a consequence, the impact on GDP per capita would be a 6% to 10% boost over 20 years.[8] The same statistics for LAMU indicates that trade would gain between 6% and 10% points while GDP per capita would be increased in 2% to 3%. As noted by Frankel and Rose, the effects are large even using conservative estimates.

For the dollarization, Mexico is the country that would benefit the most, confirming our early conjecture: its large trade with the US makes the benefits of the transactions cost reduction more relevant. In the long run,

[8] The results from Frankel and Rose should be interpreted this way, i.e., once the impact on trade settles in, it takes 20 years for the estimated impact on GDP to settle in.

its output would increase by up to 27%. Colombia would also obtain large benefits, with a boost of up to 7% points on its long run GDP. The country that would gain less with a dollarization is Brazil, with a 2% boost on its long run GDP, in the more optimistic scenario. This as a consequence of Brazil being a very large economy with a smaller relative size of trade than the other IT nations in LA. For a LAMU, Chile and Peru would benefit the most from the trade perspective. Their long run GDPs would raise by up to 6 and 5%, respectively.

An alternative way to grasp the size of these effects –one that will prove useful later when all elements considered are put together– is to calculate the present discounted value of the additional GDP due to the trade effect. Call x the % impact on long run GDP estimated under the columns 5 and 7 of Table 3. The present discounted value of the *additional* GDP due to the trade effect, expressed as a % of initial output, can be written as

$$\frac{PDV(Y^T)}{Y_0} = \frac{1}{Y_0}\sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t Y_0(1+g)^t x$$

$$= x\frac{(1+r)}{r-g}\ , \ \text{ if } r > g \tag{18}$$

where r is the real interest rate, Y_0 is real GDP in period 0, g is the assumed constant growth rate of output from period 0 onwards. Note that I am for now assuming that the effects of LAMU or dollarization on trade and then of trade on GDP occur instantaneously. This expression depends on three variables, namely, r, g and x. In Table 4, I report estimates of equation 18. In the baseline calibration, I use the same baseline values for r and g as in the seignorage estimates reported earlier, that is, 5 and 4%, respectively. As for x, I use the upper and lower limits reported in Table 3 for 2007 as well as a simple average between the two. These results are reported under columns (1) to (3). Then, under columns (4) through (9), I explore the sensibility of the results by estimating the expression for alternative values of r and g.

The results show that the effect is very large. Take first the case of LAMU. Even under the pessimistic case in terms of the impact of a common currency on trade (Low(x)), and on the country that benefits the least given that it has the lowest ratio of trade with the remaining LAMU countries (Brazil), the result suggests that the benefit is over 50% of one year's GDP.

It is conceivable that the strength of the result hinges on our assumption with regard to the timing of the effects –I assumed that trade and GDP receive an immediate boost following the adoption of a common currency. I

check what happens if the trade effects on GDP only occur 20 years after the monetary union is put in place. Table 5 reports the results. The numbers are obviously smaller than in Table 4 but the effect is still very large.

Present discounted value of trade effect on GDP expressed as % of 2007 GDP									
	LAMU								
	Baseline: r=5%, g=4%			Sensibility: x=mean(x), g=4%			Sensibility: x=mean(x), r=5%		
	x=mean(x)	x=Low(x)	x=high(x)	r=4.5%	r=5.5%	r=6.5%	g=2%	g=3%	g=4.5%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Brazil	83%	62%	103%	165%	55%	34%	28%	41%	165%
Chile	539%	405%	674%	1074%	361%	219%	180%	270%	1079%
Colombia	289%	217%	362%	576%	194%	117%	96%	145%	579%
Mexico	101%	76%	126%	201%	68%	41%	34%	51%	202%
Peru	412%	309%	515%	821%	276%	167%	137%	206%	825%
Average	285%	214%	356%	567%	191%	116%	95%	142%	570%
	Dollarization								
	Baseline: r=5%, g=4%			Sensibility: x=mean(x), g=4%			Sensibility: x=mean(x), r=5%		
	x=mean(x)	x=Low(x)	x=high(x)	r=4.5%	r=5.5%	r=6.5%	g=2%	g=3%	g=4.5%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Brazil	188%	141%	236%	375%	126%	76%	63%	94%	377%
Chile	536%	402%	670%	1067%	359%	218%	179%	268%	1072%
Colombia	627%	470%	783%	1247%	420%	254%	209%	313%	1253%
Mexico	2277%	1708%	2847%	4533%	1526%	924%	759%	1139%	4555%
Peru	463%	347%	578%	921%	310%	188%	154%	231%	925%
Average	818%	614%	1023%	1629%	548%	332%	273%	409%	1636%

Table 4

Present discounted value of trade effect on GDP expressed as % of 2007 GDP, if effect ocurrs from year 21 onwards									
	LAMU								
	Baseline: r=5%, g=4%			Sensibility: x=mean(x), g=4%			Sensibility: x=mean(x), r=5%		
	x=mean(x)	x=Low(x)	x=high(x)	r=4.5%	r=5.5%	r=6.5%	g=2%	g=3%	g=4.5%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Brazil	68%	51%	85%	149%	42%	21%	15%	28%	150%
Chile	445%	334%	557%	975%	271%	136%	101%	184%	981%
Colombia	239%	179%	299%	523%	146%	73%	54%	98%	526%
Mexico	83%	63%	104%	183%	51%	25%	19%	34%	184%
Peru	341%	255%	426%	746%	207%	104%	77%	140%	750%
Average	235%	176%	294%	515%	143%	72%	53%	97%	518%
	Dollarization								
	Baseline: r=5%, g=4%			Sensibility: x=mean(x), g=4%			Sensibility: x=mean(x), r=5%		
	x=mean(x)	x=Low(x)	x=high(x)	r=4.5%	r=5.5%	r=6.5%	g=2%	g=3%	g=4.5%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Brazil	156%	117%	195%	341%	95%	48%	35%	64%	343%
Chile	443%	332%	553%	970%	270%	135%	100%	182%	975%
Colombia	517%	388%	647%	1133%	315%	158%	117%	213%	1139%
Mexico	1881%	1411%	2351%	4119%	1146%	575%	425%	775%	4140%
Peru	382%	286%	477%	836%	233%	117%	86%	157%	841%
Average	676%	507%	845%	1480%	412%	206%	153%	278%	1487%

Table 5

5 LAMU, Dollarization or Autonomy?

The previous section dealt with three main areas that would be affected by the adoption of a common currency: business cycles, trade and seignorage. In this section, I take steps toward compiling the evidence, i.e., I discuss the relative importance of these areas.[9] Policy implications emerge.

I first discuss whether inflation targeters in Latin America should retain monetary autonomy or join together to form a common currency. The main conclusion is that each of the inflation targeters would be better off in a monetary union. I then deal with the case of a unilateral dollarization vs LAMU. Here, results are mixed. For reasonable calibrations, LAMU is strictly preferred for Chile, Peru and Brazil, dollarization is the preferred strategy for Mexico, while results are ambiguous for Colombia.

5.1 Autonomy or LAMU?

Embarking in a LAMU –compared to retaining monetary autonomy– entails one large benefit, namely the impact on trade and GDP discussed in the previous section. There should be no relevant consequences in terms of seignorage, provided that the union agreement includes a seignorage sharing rule. On the downside, although the correlation of growth rates among the LAMU nations is relatively high (especially compared with the US cycles) it is still true that the adoption of the common currency can come at the expense of exacerbating the volatility of economic activity. How costly is volatility in terms of its impact on welfare?

This question has been actively debated in the literature especially since Lucas' (1987) seminal contribution claiming that business cycle fluctuations had a negligible impact on welfare. More recently, Wolfers (2003) has used subjective wellbeing data from developed nations, showing that unemployment volatility has a negative and relatively large impact on wellbeing. Here I use an empirical strategy inspired in Wolfers' contribution to estimate whether the observed volatility in economic activity has had any impact on self-reported wellbeing statistics in the five IT nations in LA. Later, based on those results, I propose a methodology to answer the following question: Is the potential increase in volatility (due to giving up monetary autonomy) large enough to overcome the benefits via trade of LAMU?

[9] The previous section also discussed credibility aspects. Nevertheless, as mentioned, this paper makes no assumptions as to the level of credibility that a dollarization would bestow compared to LAMU. Thus, the credibility category is not included in this section.

I use data from Latinobarometro, an annual survey performed in a number of Latin-American nations since 1995. The specific question I am interested in is: *In general terms, would you say that you are satisfied with your life? Would you say that you are: very satisfied, fairly satisfied, not very satisfied, or not at all satisfied?* This question was asked in the years 1997, and 2000 through 2007.[10] I will focus on the surveys performed in the five IT nations in LA.[11] The dataset covers nine years and 5 countries –45 country-years– with 52650 valid responses. I build three alternative Life Satisfaction measures for any country c and year t.

(i) *LS1:* Following Di Tella et al. (2001) and Wolfers (2003), life satisfaction questions are coded as: 1 = "not at all satisfied"; 2 = "not very satisfied"; 3 = "fairly satisfied"; 4 = "very satisfied". Then, the simple average across individuals in any country c, for any given year t, gives the first country-year Life Satisfaction measure.

(ii) *LS2*: Following Wolfers (2003), I run an ordered probit regression on individual characteristics and a full set of dummy variables for each country in each year, with standard errors clustered at the country-year level. If wellbeing is an unobserved normally distributed variable within each country-year, this procedure estimates the cut-points between different categorizations. As Wolfers puts it "this [...] estimates numerical values for each qualitative response that are most likely given the sample proportions in the data and the assumption that the true underlying distribution of happiness is normally distributed." After obtaining the linear prediction of the latent variable for each individual, I take the average across individuals for every country-year obtaining LS2.

(iii) *LS3*: Following Di Tella et al. (2001), I run LS1 on micro controls and a full set of country and year effects.[12] The average error for each country in each year –i.e, the part of LS not explained by individual characteristics, is LS3.

The co-movement of the three LS measures over time is depicted in Figure 5.

[10] In 2002, a similar question appeared: *In general, would you say that you are very happy, fairly happy, not very happy or not at all happy?* Wolfers (2003) reports that the answers to this two questions are highly correlated in the Eurobarometer data. We assume that the same in true in the LAC case and use the happiness question in 2002 survey as if the answers between the two questions were perfectly correlated.

[11] In a companion paper focusing on self-reported happiness and macroeconomic conditions in Latin America (De Roux and Hofstetter, 2009), we extend the analysis to all country-years included in Latinobarometer.

[12] Results from this first stage are not reported, but are available form the author upon request.

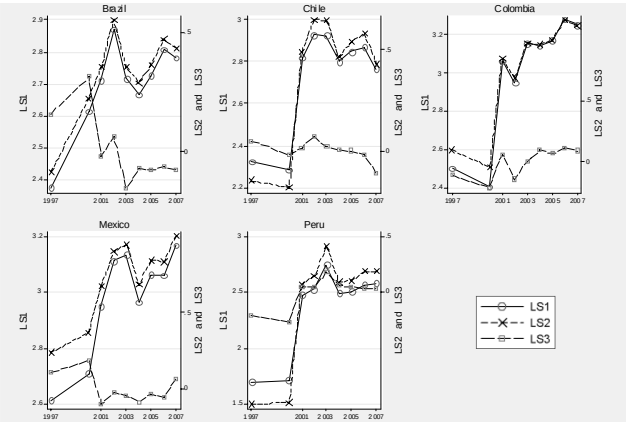

Figure 5:

Then I turn to examine whether volatility in economic activity undermines wellbeing. To do so, I estimate the convexity in preferences over growth and inflation. Specifically, I regress Life satisfaction measures against contemporaneous inflation, growth and quadratic terms for both variables.[13] The regressions include a full set of dummy variables for each country and each year. The results are reported in Table 6:[14]

The first result that stands out is the fact that inflation exhibits the expected negative sign in al cases and is significant at the 10% level in two out of three specifications. The quadratic term seems irrelevant. Consistent with the results obtained by Di Tella et al. (2001) and Wolfers (2003) for developed nations, increases in inflation seem to undermine self-reported satisfaction indexes. Second, increases in the growth rates go hand in hand with increases in self reported satisfaction levels, although with marginally decreasing effects. Although the coefficient is imprecisely estimated, the growth related variables are jointly significant.

[13] Traditionally, this literature has used unemployment series rather than GDP growth. Nevertheless, long time series of cross country comparable Unemployment rates are not available in Latin America

[14] The specification in Table 6 only makes sense if there are no negative growth rates. In our sample, there is one negative growth rate but the absolute value of the number is the smallest figure in the sample. Droping the observation does not alter the conclusions.

	LS1	LS2	LS3
Inflation	-0.046*	-0.065*	-0.039
	(0.025)	(0.036)	(0.026)
Inflation Squared	0.0016	0.0022	0.0013
	(0.0010)	(0.0014)	(0.0010)
Growth	0.036	0.048	0.055
	(0.035)	(0.049)	(0.038)
Growth Squared	-0.00025	-0.00022	-0.00174
	(0.0035)	(0.0050)	(0.0037)
Constant	2.875***	0.586**	-0.048
	(0.172)	(0.247)	(0.188)
R-squared	0.93	0.93	0.31
Adj R-squared	0.89	0.88	-0.09
# of obs	45	45	45
Joint Significance (p_values) of:			
Inflation related variables	0.134	0.130	0.198
Growth related variables	0.061	0.081	0.042
Note: Robust standard erros in parentheses. Regressions include year and country dummies. The base country is Brazil and the base year is 2007.			

Table 6

Results in Table 6 can be expressed in terms of the mean and the variance of inflation and growth. In particular, abstracting from the constants and the error term, defining $\widehat{y}$ as the output growth rate and $\bar{x}$ as the mean of x, the expected value of LS, can be written as

$$\begin{aligned} E(LS) &= E[a\pi + b\pi^2 + c\widehat{y} + d\widehat{y}^2] \\ &= b[E\pi^2 - (E\pi)^2] + b(E\pi)^2 + aE\pi + d[E\widehat{y}^2 - (E\widehat{y})^2] + d(E\widehat{y})^2 + cE\widehat{y} \\ &= bVar(\pi) + (b\overline{\pi} + a)\overline{\pi} + dVar(\widehat{y}) + (d\overline{\widehat{y}} + c)\overline{\widehat{y}} \end{aligned}$$

This allows us to estimate indifference curves, –relations between output volatility and growth that leave LS unaltered. In Figure **??**, I plot indifference curves based on the results from Table 6. The shape of the indifference curve implies that as volatility goes up, agents need to be compensated with increasingly higher growth rates to leave LS unaltered.

How much would average volatility increase with the adoption of a monetary union? There is no clear answer in the literature to this question. The experiment of the EMU took place during the time of the Great Moderation. We did not observe average increases in the volatility of economic activity. The recent dollarization of Ecuador is also not a good parallel, as it took place in times of economic turmoil, and dollarization was the chosen policy to alleviate economic instability.

Nevertheless, economists have argued that there are forces associated with the monetary union that should attenuate the increase in volatility over time, as the trade among the members increases and the policies converge. Indeed, Frankel and Rose (1997) show that business cycles synchronization increases with trade links and, thus, a monetary union will *ex-post* yield to

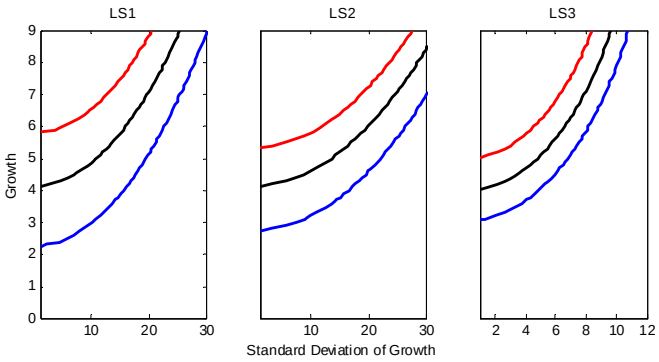

Figure 6: Indifference curves. Continuous lines pass through the sample mean of growth and Standard Deviation of growth

more tightly correlated business cycles. Moreover, convergence in monetary and fiscal policies have recently been shown to have a quantitative impact comparable to the trade effect on business cycle synchronization (Inklaar et al., 2008). Thus, even though economists are unsure of how large the increase in volatility would be, all this evidence suggests that the increase due to the monetary union should dissipate over time.

As explained earlier, these indifference curves are an input to approach the following question: Is the impact of the increase in volatility potentially large enough to overcome the benefits via trade of LAMU? To answer this question, I use the following conterfactual: what kind of an increase in volatility is needed to exactly offset the benefits via trade of LAMU? Here are the detailed steps to implement an empirical strategy to answer the question:

- On the one hand, I estimate the present discounted value of GDP including the effect of trade. In the baseline, I focus on the case where trade increases GDP 20 years after the common currency is adopted. The present discounted value of the GDP if LAMU is adopted in period 0, including the benefits via trade, can be written as:

$$PDV(Y^{Tr}) = \sum_{t=0}^{19} \left(\frac{1}{1+r}\right)^t Y_0(1+g)^t + \sum_{t=20}^{\infty} \left(\frac{1}{1+r}\right)^t Y_0(1+g)^t(1+x)$$

- I then ask what increase in growth (later converted to an equivalent increase in volatility via indifference curves) is needed to match these benefits. In the baseline, I assume that the increase in volatility occurs

as soon as the common currency is adopted and lasts for 20 years. The expression I am interested in is

$$PDV(Y^{\sigma}) = \sum_{t=0}^{19} \left(\frac{1}{1+r}\right)^t Y_0(1+g+\varepsilon)^t + \sum_{t=20}^{\infty} \left(\frac{1}{1+r}\right)^t Y_0(1+g)^t$$

where ε is the additional growth (again, later converted to additional volatility) needed to match the benefits via trade. I estimate ε numerically. Note that for each country, I have specific x's and thus ε's.

- Having country specific ε's, I use the indifference curves to calculate the implied increase in volatility, for each country, that would offset the benefits from the common currency via trade.[15] . The indifference curves are also country specific in the sense that each of them passes through the respective growth and standard deviation means. Table 7 reports the ε's and the implied increase in volatility.

On average, in the baseline case, ε is 1,3% and the implied volatility increase –averaging across LS estimations– is 502%, a very large figure. To put it in perspective, Blanchard and Simon (2001) document that the variability of quarterly growth in real output (as measured by its standard deviation) in the US has declined by half since the mid-1980s. A similar phenomena occurred in many countries around the world in a the process that has been dubbed the Great Moderation. If such a striking process cut volatility by half over three decades, increasing the volatility by almost 500% following the monetary union, with the relatively high correlation of business cycles identified earlier, seems implausible. It follows that under the baseline scenario, the trade effect has a larger impact than the volatility increase.

I perform in the same Table a couple of robustness checks. On the one hand, I report results if the trade effect takes its lowest value. On the other hand, I also check the outcomes if the trade effect only takes place after 30 years and the volatility increase lasts 30 years. On average, both cases suggest that the implied volatility increases still needs to be (too) large to offset the gains in the trade front. The country with the smallest implied

[15] Note that in comparing the $PDV(Y^{\sigma})$ and $PDV(Y^{Tr})$ I use the baseline value for g, namely 4%. Later, estimating the increase in volatility, I use country specific indifference curves, namely the ones that cross though the average growth and standard deviation of each country. Robustness checks, not reported here, show that none of the conclusions in the section are altered if we try alternative values for g in the first step of the estimation of the volatility increase.

increase in volatility is Mexico. Still, the implied average increase is above 100%. Moreover, I should recall that Mexico is, together with Brazil, the largest economy in Latin America. In this sense, the joint business cycle of the five IT nations and the policy decisions of the potential LAMU's Central Bank, would be highly dependent on the Mexican cycle. Expecting that the union would increase the Mexican volatility by over 100% is also unlikely.

Baseline

	ε(%)	Implied increase in volatility (%)			
		LS1	LS2	LS3	Average
Brazil	0.4	388	502	123	338
Chile	2.4	1200	1524	408	1044
Colombia	1.4	573	737	184	498
Mexico	0.5	255	335	74	221
Peru	1.9	505	654	74	411
Average	1.3	584	750	173	502

x=low(x)

	ε(%)	Implied increase in volatility (%)			
		LS1	LS2	LS3	Average
Brazil	0.3	327	425	101	284
Chile	1.9	1047	1332	355	912
Colombia	1.0	491	633	155	426
Mexico	0.4	212	281	59	184
Peru	1.5	434	564	59	352
Average	1.0	502	647	146	432

Volatility increase lasts 30 years

	ε(%)	Implied increase in volatility (%)			
		LS1	LS2	LS3	Average
Brazil	0.2	242	318	70	210
Chile	1.2	810	1033	270	704
Colombia	0.6	371	482	112	321
Mexico	0.2	154	207	40	133
Peru	0.9	326	428	40	265
Average	0.6	380	494	106	327

Table 7

To sum up, the results suggest that the potential increase in volatility that each member country might face when forming a monetary union does not have a first order impact on well-being–at least not if compared with the positive impact via trade. These results suggest that LAMU should be preferred to monetary autonomy.

5.2 Dollarization or LAMU?

I now examine whether LAMU is also a preferred monetary arrangement compared with a unilateral dollarization. The benefits via trade of dollarizing are greater than those of LAMU, except in Chile. On the downside, dollarizing implies a loss of seignorage and a potential greater exacerbation

of volatility. Here I take a look at the relative importance of these effects under alternative scenarios. I begin with trade and seignorage and later turn to the volatility issues.

Table 3 showed that for all IT nations in LA except Chile, trade with the US is larger than trade with the other IT countries in the region. Table 2 showed that seignorage income forgone is large. What is the net impact of those effects? In Table 8, I report the present discounted value of the trade effect on GDP of dollarizing, net of the same effect if countries adopt LAMU. Both trade effects are calculated as if the impact of the common currency on trade and GDP occurred instantaneously. To this *net* trade effect, I substract the seignorage foregone if countries dollarize also measured as the present discounted value as a % of GDP in 2007. If the numbers in the Table are positive, dollarization is preferred to LAMU. The opposite is true if the numbers are negative.

Impact of common currency: Trade effects of dollarization - Trade effects of Lamu - Seignorage foregone under dollarization. Effects reported are present discounted values (% of GDP in 2007)

	r= 5%, g=4%, π=3%			x=mean(x), g=4%, π=3 %			x=mean(x), r=5%, π=3%			x=mean(x), r=5%, g=4%			x=low(x), r=5%, g=4%		
	x=mean(x)	x=Low(x)	x=high(x)	r=4.5%	r=5.5%	r=6.5%	g=2%	g=3%	g=4.5%	π=2%	π=4%	π=5%	π=2%	π=4%	π=5 %
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Brazil	23%	-4%	49%	55%	12%	3%	8%	11%	45%	33%	12%	1%	7%	-15%	-25%
Chile	-91%	-91%	-92%	-171%	-65%	-44%	-30%	-46%	-183%	-80%	-103%	-114%	-79%	-102%	-113%
Colombia	260%	175%	344%	527%	171%	99%	87%	130%	519%	270%	250%	240%	185%	165%	155%
Mexico	2133%	1589%	2677%	4251%	1427%	862%	711%	1067%	4266%	2139%	2127%	2122%	1595%	1583%	1578%
Peru	-64%	-76%	-51%	-113%	-48%	-35%	-21%	-32%	-128%	-49%	-79%	-93%	-62%	-91%	-106%
Average	452%	319%	585%	910%	299%	177%	151%	226%	904%	462%	442%	431%	329%	308%	298%

Table 8

Under the baseline case (1), Chile and Peru show up with negative numbers. For the rest of the countries, the benefits of dollarization overcome those of LAMU, if only considerations of trade and seignorage are taken into account. The positive/negative split changes in Brazil when either the Trade effects are low ($low(x)$) or when inflation (seignorage) picks up.

The previous Table made the unreasonable assumption that the trade effects occur as soon as the common currency is adopted. Table 9 reports results if the trade effects occur 20 years after the monetary union is formed.

Obviously, negative numbers continue to show up for Chile and Peru. In Brazil, now 2/3 of the columns show up with negative numbers, reenforcing the notion that LAMU might be preferred to dollarization under alternative reasonable scenarios. Colombia and Mexico are the only cases where, when trade and seignorage are the solely concerns in the comparison between LAMU and dollarization, the latter appears consistently as the preferred

strategy. This is obviously the consequence of Mexico and Colombia being the countries with the highest proportion of trade with the US.

Impact of common currency: Trade effects of dollarization - Trade effects of Lamu - Seignorage foregone under dollarization, with trade effects taking place from year 21 onwards. Effects reported are present discounted values (% of GDP in 2007)

	r=5%, g=4%, π=3%			x=mean(x), g=4%, π=3%			x=mean(x), r=5%, π=3%			x=mean(x), r=5%, g=4%			x=low(x), r=5%, g=4%		
	x=mean(x)	x=Low(x)	x=high(x)	r=4.5%	r=5.5%	r=6.5%	g=2%	g=3%	g=4.5%	π=2%	π=4%	π=5%	π=2%	π=4%	π=5%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Brazil	4.2%	-18%	26%	36%	-6%	-13%	-8%	-6%	26%	15%	-7%	-17%	-7%	-28%	-39%
Chile	-91%	-90%	-92%	-170%	-64%	-43%	-30%	-45%	-182%	-79%	-102%	-114%	-79%	-102%	-113%
Colombia	201%	131%	271%	465%	114%	48%	37%	76%	458%	211%	191%	181%	141%	121%	111%
Mexico	1754%	1305%	2203%	3855%	1064%	528%	392%	719%	3870%	1760%	1748%	1743%	1310%	1299%	1293%
Peru	-73%	-83%	-62%	-122%	-56%	-42%	-29%	-40%	-137%	-58%	-87%	-102%	-68%	-98%	-112%
Average	359%	249%	469%	813%	210%	95%	72%	141%	807%	370%	349%	338%	259%	239%	228%

Table 9

To sum up, with trade and seignorage consideration in balance, I have two cases where LAMU is always the preferred strategy (Chile and Peru), two cases where the dollarization seems more appropriate (Colombia and Mexico) and one case where there is no clear-cut answer (Brazil).

Would these conclusions change if I add to the count the effect of volatility? For the Mexican case, the answer is clearly no. On the one hand, the Mexican correlation of business cycles with LAMU and with the US is almost identical and thus one should not expect very different increases in volatility when comparing the dollarization to LAMU. On the other hand, the *net* gains from trade of dollarizing even after taking into account the seignorage losses are very large. No reasonable change in volatility could offset those gains.

As for Chile and Peru, even without volatility considerations, LAMU is the preferred strategy. Since the volatility increase would be worse with dollarization than with LAMU, this would only make LAMU even more attractive vis a vis the dollarization.

As for Brazil, while in Table 9 several negative signs showed up, that is, LAMU is preferred to dollarization, some columns showed positive numbers, i.e., cases when dollarization is preferred. What increase in volatility is needed to offset the advantage of dollarization in the *worst* scenario from the point of view of LAMU (column 4)?[16] Using the indifferecence curve strategy outlined above, the answer is a 38.1% average increase in volatility. Given that Brazil is the main driver of the business cycle of LAMU and that its correlation with the US is very low, this relative increase in volatility is plausible. This together with the fact that negative numbers showed up in Table 9 (without taking into account the volatility factors), lead us to

[16] This is, vis a vis a zero threshold increase in volatility in the case of LAMU.

conclude that for reasonable calibrations, the large gains in the trade front posted by the dollarization are overturned by the sum of trade gains from LAMU, and seignorage foregone and the relative volatility increase in the dollarization.

As for Colombia, to overturn the relative advantage of dollarization in the baseline case in Table 9, one would need an average increase in volatility of 131%. Even though Colombia has a very low synchronization of the cycle with the US, a 131% increase in volatility seems too large a number to be expected. Nevertheless, if I focus on the average of the two lowest figures for Colombia in Table 9 and calculate what increase in volatility would overturn it, the answer is a 30.8% increase. Such an increase in volatility if Colombia were to dollarize –considering the very low synchronization of its business cycle with the US– seems plausible. I conclude that, even though in most calibrations for Colombia the dollarization seems to have the edge, there are plausible combinations were the choice is a close call.

Thus, there are three countries –Chile, Peru and Brazil– where LAMU seems a better alternative, one case where LAMU and dollarization are close to indifferent –Colombia– and one case where dollarization is clearly the preferred case –Mexico. But of course, a common currency strategy, be it dollarization or LAMU, is preferred to monetary autonomy in all cases. As Dornbusch once stated, convergence on regional monies is a no-brainer.

6 Concluding Remarks

The policy lessons that emerge from the paper are clear: IT nations in Latin America should consider more seriously giving up monetary autonomy. The paper has been framed, from the beginning, within the IT countries. This is not a coincidence: a successful monetary union needs converging monetary institutions in terms of goals and strategies. From the point of view of trade, a monetary union between Argentina and Brazil or between Colombia and Venezuela, would make sense. Nevertheless, the monetary institutions, strategies and goals of Venezuela and Argentina are very distant from the IT framework that Colombia and Brazil share. That is why non-IT countries are not considered in this paper.

A topic that the paper has not considered regards the political barriers that giving up monetary autonomy faces. The national currency is part of the national identity and thus -even if there was no debate about the economic benefits of abandoning the national currency– there will always be public opinion resistance to monetary unions. If a consensus among

policy-makers emerges along the lines of the economic benefits of a LAMU, a careful strategy to explain to the public the costs-benefit analysis should be planned. The European experience has shown that this is not an easy task. As mentioned in the introduction, it seems more plausible to overcome the resistance to giving up monetary autonomy in favor of a new Latin American currency than it is to adopt the dollar. In many sectors of the region anti-amercanism remains high and often reappears as a useful political tool.

For the policy implications of the paper to become part of the regional agenda, an active engagement of Brazil will be essential. In the last years, Brazil has become the indisputable political leader in the region and the main economic force. Without an active engagement of the regional leader, this agenda has no political future. There have been recently some signs that Brazil would be willing to move along the lines suggested by the paper. President Lula has been pushing to allow the trade transactions among countries in the region with Brazil to be paid for in local currencies rather than US dollars. Of course, this will not eliminate exchange rate uncertainty and seems designed to weaken the role of the dollar in the region rather than to bolster trade. Still, this could be read as preliminary steps towards taking more seriously the policy lessons from the paper.

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Appendix

Differences in Preferences: the Short-Run

Let the shocks be identical across the economies, i.e., $\varepsilon = \varepsilon_j$ so that $\sigma_{\varepsilon}^2 = \sigma_{\varepsilon_j}^2 = \sigma_{\varepsilon\varepsilon_j} = \sigma^2$. Here I do *not* assume that $\Theta_j = \Theta = 0$; precisely, the goal is to explore the role of Θ_j and Θ in determining the welfare implications of joining a union. Then, $E\Delta\mathcal{L}_j$ can be written as

$$E\Delta\mathcal{L}_j = (11)+ \\ \frac{1}{2}\left[\left(\frac{h\Theta}{1+h}\right)^2 - \left(\frac{h_j\Theta_j}{1+h_j}\right)^2 - 2\left(\frac{\lambda h\Theta\overline{U}_u}{(1+h)^2} - \frac{\lambda_j h_j\Theta_j\overline{U_j}}{(1+h_j)^2}\right)\right] \quad (19)$$

where the sign of the new line depends on the relative size of the other parameters in the model. I explore differences in each of them, one at a time.

A1. Let $\overline{U_j} \neq \overline{U_u}$; $\lambda_j = \lambda$, $h_j = h$, $\Theta_j = \Theta$. Then $E\Delta\mathcal{L}_j$ can be written as

$$(12) - \frac{\lambda h\Theta}{(1+h)^2}\left(\overline{U_u} - \overline{U_j}\right) \quad (20)$$

The new term is negative if $\left|\overline{U_j}\right| > \left|\overline{U_u}\right|$ and if $\Theta > 0$. That is, if the inflation target is above the optimal rate and country j has more ambitious unemployment goals, joining a monetary union will be even more welfare increasing for j. The credibility the monetary union bestows has a higher impact on welfare when the union occurs among inflation targeters.

A2. Let $\lambda_j \neq \lambda$; $\overline{U_j} = \overline{U_u}$, $h_j = h$, $\Theta_j = \Theta$. Then $E\Delta\mathcal{L}_j$ can be written as

$$(13) - \frac{h\Theta\overline{U}_u}{(1+h)^2}\left(\lambda - \lambda_j\right) \quad (21)$$

The new term is again negative as long as $\Theta > 0$ and $\lambda < \lambda_j$. The interpretation is analogous to the previous case.

A3. Let $h_j \neq h$; $\overline{U_j} = \overline{U_u}$, $\lambda_j = \lambda$, $\Theta_j = \Theta$. Then $E\Delta\mathcal{L}_j$ can be written as

$$(14) + \frac{\Theta^2}{2}\left(\left(\frac{h}{1+h}\right)^2 - \left(\frac{h_j}{1+h_j}\right)^2\right) - \Theta\lambda\overline{U}_u\left(\frac{h}{(1+h)^2} - \frac{h_j}{(1+h_j)^2}\right) \quad (22)$$

For interpretation purposes, I consider the case where $h_j < h$, namely a scenario where the Union's Central Bank attaches a higher priority to the achievement of the inflation target. The two new terms are positive as long as $\Theta > 0$. The message they convey is intuitively clear: if the union's Central Bank attaches a greater weight to the inflation target and the latter is above the optimal rate, then joining the union decreases welfare.

A4. Let $\Theta_j \neq \Theta$; $\lambda_j = \lambda$; $\overline{U_j} = \overline{U_u}$, $h_j = h$. Then $E\Delta\mathcal{L}_j$ can be written as

$$\frac{1}{2}\left(\frac{h}{1+h}\right)^2\left(\Theta^2 - \Theta_j^2\right) - \frac{2h\lambda\overline{U}_u}{(1+h)^2}\left(\Theta - \Theta_j\right) \tag{23}$$

The expressions says that the higher Θ_j with respect to Θ the greater are the gains of joining the union. By joining the union, country j adheres to a Central Bank that targets an inflation rate closer to the optimal, reducing the bias generated by the discrepancy between the target and the optimal rate. In this scenario, joining the union will unambiguously be welfare improving.

About the Indexes of Central Bank Independence (CBI)[17]:

GMT comes from the work of Grilli, Masciandaro and Tabellini (1991). GMT observes 15 criteria each one with a score of zero or one. The overall index is obtained by addition. A higher score indicates higher CBI. In this index, political independence is defined in terms of central bank responsibilities, procedures for appointing central bank government bodies and the level of government control over monetary instruments. Economic independence is defined in terms of restrictions to finance fiscal deficits and the role the central bank plays in banking supervision.

The **Cukierman index** is based on 16 criteria of political and economic independence. The index uses a continuous scale from zero to one. The overall index is obtained using a weighted average of the individual criteria. Political independence is based on the characteristics of the appointment and dismissal of the central bank's governor and the independence for policy formulation. In terms of economic independence, a central bank is better rated if the provisions for monetization of the fiscal deficit are restrictive. In addition, the index is higher if there is a legal mandate to focus on price stability.

The **Modified Cukierman Index (MCI)** changes some of the 16 criteria considered by the Cukierman index. MCI maintains the four general classification criteria of the Cukierman index but adds a new category for central bank accountability. There are four main changes in the index: i)

[17] This appendix is based on the descrption provided in Jacome and Vazquez (2005).

MCI assesses characteristics of the appointment and dismissal of the entire board of directors of the central bank. ii) MCI includes the CBI in terms of exchange rate policy. iii) Two additional criteria are included: central bank faculties as governing lender of last resort and provisions that secure central bank financial autonomy. For example MCI rewards the existence of limits to the central bank involvement in banking crises. iv) MCI adds criteria for accountability. For example, MCI rewards legal provisions that force central banks to report on a regular basis their policy targets and achievements. Also, a better MCI is obtained if the central bank financial statements are published on a regular basis.